*California*
*Commission on Teacher Credentialing*

*Meeting of*
*March 6-7, 2002*

**AGENDA ITEM NUMBER:** **PREP – 1**

**COMMITTEE:** **Preparation Standards Committee**

**TITLE:** **Proposal to Establish a Limited Authorization Single Subject Teaching Credential in Science**

**__X__ Action**

**_____ Information**

**_____ Report**

**Strategic Plan Goal(s):**

**Goal 6:** **Provide leadership in exploring multiple, high quality routes to prepare professional educators for California schools**

- Work with education entities to expand the pool of qualified professional educators

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# Proposal to Establish a Limited Authorization Single Subject Teaching Credential in Science

## Professional Services Division

**February 11, 2002**

### Executive Summary

In recent months concerns have emerged regarding the number and distribution of qualified science teachers in California public schools. The number of less than fully qualified Single Subject science teachers has more than doubled during the past five years, while the number of prepared and recommended Single Subject science teachers from California colleges and universities has remained essentially constant. In addition the distribution of teachers qualified to teach advanced and Advanced Placement science courses in high schools is uneven.

This agenda item asks the Commission to consider establishing a limited teaching authorization for the Single Subject Teaching Credential in Science. This limited authorization would apply to individuals who hold an advanced degree or its equivalent in one of four science areas - biology, chemistry, physics, or geo-science. These advanced degree holders would demonstrate completion of the Commission's subject matter requirement through verification of the degree or a degree equivalent. Other prospective teachers for this limited authorization could meet the subject matter requirement by achieving a passing score on a Commission-adopted subject matter examination.

Other Single Subject Credential requirements such as CBEST, Certificate of Clearance, U.S. Constitution, and completion of approved program of teacher preparation through an internship or student teaching program would continue to apply. Upon meeting all requirements, these individuals would be recommended for a Single Subject Teaching Credential with an authorization to teach in the science area of the advanced degree.

### Policy Issue to be Considered

Should the Commission direct staff to develop a "limited authorization" for Single Subject Teaching Credential in Science?

### Fiscal Impact Statement

Funds for the development of a full proposal to the Commission would be obtained from the existing 2001-2002 budget of the Professional Services Division.

### Recommendation

That the Commission direct staff to develop a "limited authorization" for the Single Subject science credential, and report back to the Commission within a three month period.

**Proposal to Establish a Limited Authorization**
**Single Subject Teaching Credential in Science**

**Professional Services Division**

**February 11, 2002**

## I. Introduction

In recent months concerns have emerged regarding the number and distribution of qualified science teachers in California public schools. The number of less than fully qualified Single Subject science teachers has more than doubled during the past five years, while the number of prepared and recommended Single Subject science teachers from California colleges and universities has remained essentially constant. In addition the distribution of teachers qualified to teach advanced and Advanced Placement science courses in high schools is uneven. This agenda item examines background factors salient to questions of science teacher preparation and recommends the Commission authorize staff to develop a new pathway for science teacher preparation through a modification of the current authorization of the Single Subject Teaching Credential in science.

## II. Background - Science Teaching in California Today

### Recent Single Subject Credentials in Science Issued

Data collected in the Commission's Credentials, Assignments and Waivers Division indicate that the number of candidates receiving science credentials has remained below 1000 since 1997-98. The number of first time/new type Single Subject Credentials (preliminary or professional clear) issued varies from year to year, with a slight downward trend. In 1997-98, 977 credentials were issued; in 1998-99, 748 were issued; and in 1999-2000, 845 credentials were issued. In the 1999-2000 year, the science subject matter distribution of credentials was as follows:

- Life Science: 71
- Physical Science: 10
- Biological Sciences 491
- Chemistry 120
- Geosciences 76
- Physics 77

At the same time the number of emergency permits issued in science has increased steadily from 1377 in 1995-96, to 2728 in 1999-2000. This represents 21% of the science teachers currently in California public schools. Fifty eight percent (58%) of those emergency permits were issued in Life Science or Biological Science. In the 1999-2000 year, biological science courses constituted 21% of all science classes taught in the state.

**Science Offerings in Schools**

The California Department of Education collects data annually on the types and numbers of science classes offered in California public schools. Table 1 describes the science offerings in California Secondary Schools for the 2000-2001 academic year.

**Table 1. Science Classes in California Public Schools, 2000-2001**

| Science Area | Total Classes Offered | Per Cent of Total Classes Offered |
|---|---|---|
| General Science | 23,074 | 34% |
| Biology, Life Science, Botany, Zoology | 14,020 | 21% |
| Chemistry, Advanced Chemistry, Conceptual Chemistry | 5,963 | 9% |
| Physics, Advanced Physics, Energy, Motion and Forces | 2,722 | 4% |
| Physical Science | 6,203 | 9% |
| Geo-science, Earth and Planetary Science, Space Science, Meteorological Science, Geology | 2,875 | 4% |
| Coordinated, Integrated Science | 6,732 | 10% |
| Miscellaneous Science Classes | 6,346 | 9% |
| **Total Science Classes**: | 68,035 | |
| **Total Teachers** | 13,305 | |
| **Average Class Size:** | 29.3 | |

The data reveal that 55% of science teaching takes place in either general science or biology, with integrated science, physical science and chemistry accounting for another 28%. Physics and geo-sciences are least frequently taught.

**Availability of Advanced Placement Classes**

Advanced Placement (AP) courses in science have shown strong growth in recent years, reflecting increasing expectations, high standards, and measurable accountability for high school offerings. Biology and Chemistry are among the nine subjects that account for approximately 80% of AP exams taken, with Physics also commonly offered. Since 1997, the number of AP exams taken by public school students in California has increased by 48.3%, while high school enrollments have only grown by 13.5% in this same period. The Institute for Education Reform (IER) of the California State University

published studies on AP course development in California in 1999 and 2001, one of which extensively examined course parameters in five AP courses, including chemistry.

The studies reveal that teachers who teach AP courses have the opportunity to stretch their capacity, teaching college-level material, and that AP exam results provide external, standardized validation of a teacher's ability to help students achieve high levels of performance. Although more than 90% of California's high schools offer AP courses, many students across all ethnicities and socio-economic strata have limited AP opportunities. Participation in AP classes by Hispanics and African-Americans is generally substantially lower than their share of total school enrollment, although the 1999 study was unable to determine why this is so. Passing rates on AP tests are strongly linked to school socio-economic status indicators. In the 2001 study of chemistry and four other AP courses, possession of a doctorate by the teacher correlated with higher student performance in high SES schools (only 1 AP teacher in low SES schools had a doctorate). Teacher experience in teaching AP courses was also cited in improving student performance, a critical issue given that many AP teachers will soon be retiring, as noted in the 2000 report.

**Effect of Teacher Advanced Degrees on Student Performance**

The effect of advanced degrees in a content area by teachers on the subsequent achievement by their students is difficult to ascertain. However, one relatively recent study (David H. Monk, 1994, *Economics of Education Review*, **13** (2), pp. 125-45) demonstrated that subject matter preparation did enhance student achievement. The study concluded that subject matter knowledge was a necessary component of a well-qualified teacher, although pedagogical preparation was also necessary for effective teaching.

## III. Science Teacher Preparation in California Today

Prospective teachers of science in California public schools must complete both subject matter and pedagogical preparation in science for the Single Subject Credential. Subject matter preparation must be substantially completed prior to advancement to student teaching in the pedagogical preparation program or completed prior to assuming intern duties in internship programs. Candidates are recommended for a science credential, with the subject area of emphasis indicated on the document, upon successful completion of both the subject matter requirement and a Commission-approved program of teacher preparation. This credential authorizes teaching general or integrated science as well as a specific area of emphasis – biological sciences, chemistry, geosciences or physics.

To meet the current subject matter requirement in science, prospective teachers must demonstrate subject matter knowledge in general science and in a specific science emphasis (biological sciences, chemistry, geosciences, or physics). Future teachers may demonstrate subject matter competence by completion of a Commission-approved subject matter program or by obtaining a passing score on specified Commission-adopted examinations. Presently, there are 78 four year colleges and universities in California that are accredited by the Commission. Seventy of these 78 institutions have approved single subject programs. Of the seventy institutions, 29 institutions have approved

subject matter programs in biological sciences; 23 in chemistry; 23 in physics; and 20 in geosciences.

Students not completing an approved subject matter program may satisfy the subject matter requirement by achieving passing scores on the requisite examinations. During the period 1995-98, the percent of credentialed science teachers who satisfied the subject matter requirements by examination were: biological sciences, 27%; chemistry, 22%; geosciences 36%; and physics, 21%. Exam takers are asked to provide information about their academic preparation on their registration materials. While 12% of those who took the exams from December 1995 through June 1998 claimed a masters degree or above (discipline unspecified), 43% of the exam takers did not provide information about their academic preparation.

Passing rates for Praxis and SSAT exams vary according to a number of factors, including the possession of an advanced degree. Cumulative passing rates (multiple attempts) for exam takers who claim a Masters degree and above (during 12/95-6/98) were 59%; lower passing rates were found for exam takers who were undergraduate students (49%); Bachelors degree holders (44%) and Bachelors degree + units (40%). Overall first time passing rates (during 12/95-6/98) for undergraduates (43%) were approximately equal to those claiming a Masters degree and above (40%), with other types of preparation at approximately half of those levels. Thus, the exam route seems most advantageous to undergraduates (who were presumably taking courses that related directly to the exams) or those holding advance degrees in the sciences.

The present Title 5 requirement for an approved Single Subject subject-matter program in science is at least 45 semester units or 68 quarter units of coursework in science and closely related subjects. Each approved program includes breadth courses and one or more concentrations. Breadth courses address the foundations in biological sciences, chemistry, physics and geosciences and consist of at least 24 semester units or 36 quarter units of study. A concentration provides depth of study in one area of science selected by the prospective Single Subject science teacher. In each concentration, the depth courses ~~are to~~ comprise at least 18 semester units or 27 quarter units beyond those taken in that science area to meet the breadth requirement. Three semester units are taken as an elective to bring the total program units to 45 semester units. These unit requirements are a minimum. It is possible for an institution to require more breadth, depth or total units than are required in Title 5. Table 2 on the following page illustrates the present structure of the Single Subject subject-matter preparation programs for the science credential.

Currently, an advisory panel appointed by the Executive Director is developing proposals to change the Standards of Program Quality and Effectiveness for Subject Matter Preparation Programs and the Subject Matter Requirements (SMRs) in science. It is expected that the panel will present its proposals for changes to the Commission in early fall, 2002.

**Table 2. Single Subject Science Subject Matter Program Structure**

| **Total Approved Program (at least 45 semester units)** | | | |
|---|---|---|---|
| Breadth Requirement<br>24 Semester Units | | | |
| **Concentration** | **Concentration** | **Concentration** | **Concentration** |
| Biology<br>18 semester units | Chemistry<br>18 semester units | Physics<br>18 semester units | Geosciences<br>(Earth & Planetary Sci.)<br>18 semester units |

## IV. Summary

It is not possible to draw clear conclusions about how various factors influence the number of science classes, including AP classes, available in schools throughout the state. However, given the small annual number of newly certified teachers, the large numbers of under-qualified teachers, and the relatively low rates of taking and/or passing Praxis/SSAT examinations in science, it seems reasonable to suggest that the Commission take steps under the scope of its authority that would potentially increase the pool of qualified science teachers. One relatively untapped source of potential well-prepared science teachers may be those with advanced degrees in science fields, who decide, as career changers, to enter the teaching profession. Their subject matter preparation has already been demonstrated in their chosen field of study through their advanced degrees, albeit in a single science discipline. Allowing them to earn a limited science authorization in that field would provide additional flexibility for those considering a career as a science teacher and provide flexible staffing options for districts and schools who currently have difficulty finding credentialed teachers in science.

## V. Proposed Changes

Given the current picture of science teaching today, staff recommend that the Commission establishing a limited teaching authorization in Single Subject science. The proposed limited authorization would be for prospective science teachers to teach in one or more of four science areas (biology, chemistry, physics, and geoscience) taught in K-12 California public schools.

### Three Options for Commission Consideration

As a preliminary step, staff have identified three options for a limited teaching authorization. These options are intended to illustrate how this credential pathway could be developed, and should not be considered as a finite or final set. All three options could be endorsed by the Commission as routes to the subject matter requirement.

Option 1: Any prospective Single Subject teacher with an advanced degree (Masters or Doctorate) in any of the four science areas, or closely related areas, will have met the subject matter requirement for a Single Subject science credential with limited authorization in the subject area of the degree; and/or

Option 2: Any prospective Single Subject teacher with 30 semester units of advanced (postgraduate) work in any of the four science areas will have met the subject matter requirements for a Single Subject science credential with a limited authorization in the subject area of the advanced coursework; and/or

Option 3: Any prospective Single Subject teacher who successfully passes an examination in one of the four science areas for Single Subject teaching will have met the subject matter requirements for a Single Subject science credential with a limited authorization in that subject area.

**Next Steps**

If this recommendation is adopted by the Commission, the following actions will be initiated:

- Staff will review its examinations for appropriateness with each of the four "limited authorizations" in science.
- Staff will identify all necessary steps to be taken requiring possible legislative action, and changes that would need to be made in Title 5 regulations.
- Staff will prepare an implementation plan for the establishment of the "limited authorization" science credential.
- Staff will prepare an agenda item for Commission action at their May or June 2002 Commission meeting.

**Recommendation**

Staff recommend that the Commission authorize further development of the proposed Limited Authorization Single Subject Credential in Science.